

# Quasi-Experimental Study of the Predictive Value and Association of Blended Learning to Test Performance Ratings

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## Abstract

Using pretest and posttest experimental research design involving 62 participants, this study determined whether the blended learning mode of instructional delivery was more effective than face-to-face learning in improving the academic performance of the students. The study found out that blended learning is effective in improving the test scores of the treatment group ( $t\text{-Stat}=-6.529$ ), ( $t\text{-Critical}= 1.697$ ), and ( $p=0.00$ )). 19.70% of the observed variance on the test scores of participants exposed to blended learning can be ascribed to blended learning with the other 80.30% possibly caused by other factors. Analyses of associations using Point Biserial Correlation Coefficient revealed that there is a substantial positive association ( $R_{pb} = 0.5610429$ ) between exposure to blended learning and changes in the test scores of the students exposed to it. The study could be utilized as basis for HEIs on making necessary adjustments or improvements for better implementation of the program. The over- all result of the study can also be used as reference in using the BLP in other general education subjects.

Keywords:

blended learning, online learning, performance rating, instructional delivery, learning management system

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## 1. Introduction

The concept of blended learning has been around for a long time, but its terminology was not firmly established until around the beginning of the 21st century. Blended learning can be defined as learning systems that combine face-to-face instruction with computer mediated instruction (Graham, 2013). It involves combining internet and face-face physical co-presence of teacher and students (Poon, 2013). If properly implemented, it is a promising alternative learning approach compared to conventional and e-learning approach, and can improved student success, satisfaction, and retention (University of Central Florida, 2015).

A myriad of international studies show that universities and schools are working toward effectively integrating information technology and face-to-face classroom interaction in the delivery of their course content. The use of laptops and the internet has produced the technological conditions for instructors and students can take advantage from the diversity of online information, communication, collaboration and sharing with others (Lopes, 2017). Internet education now is not only an established phenomenon but also a growing industry. During the past few years the number of courses offered online has greatly increased as technology has made delivery of such courses more feasible (Vernadakis, Derri & Michalopoulou, 2014). Technologies and their use have made big changes in education, since is changing its paradigms, from a closed model, and teacher-centered classroom to a model more open and student-centered, where the teacher moves from one holder of knowledge for a learning mentor, able to manage diverse discourses and performs as well as stimulate the intellectual capacities of students in the treatment of information and include online learning, hybrid learning and collaborative models (Johnson, Adams, and Cummins, 2012).

According to Martin, Parker and Deale (2012), a number of characteristics of online education have their roots on distance education. Amongst the main features of e-learning platforms are flexibility, accessibility, focusing on the student, the economy or rationalization of resources, interactivity and enhancement of the student. Phillips, McNaught, and Kennedy (2012) believe that the key success to transformed models of online learning and teaching is the active participation and collaboration by students in problem solving and knowledge production. The communications resources of the web may make it more efficient to communication between teacher and students, when compared with other conventional methods. Moreover, Park (2011), as cited by Lopes (2017) emphasized that instructors need to

be aware that the standardized formats available in the learning management system (LMS) have generalized disciplinary characteristics and pedagogical development.

The process of education aims to enhance the academic performance of the students whether online or face-to-face. A holistic approach to learning can yield positive results although academic performance is dependent on many variables such as intelligence, socio-economic status, personal characteristics, attitude, values, environment and teaching-learning techniques. To optimize the educational opportunities, it is necessary to find out the relation between the teaching methodology and academic achievement (Chandra, 2015). In this context, this study evaluated the blended learning approach of the National University (NU) and its relationship to the academic performance of the students.

The NU, one of the premier Higher Education Institutions (HEIs) in the Philippines, has adopted blended learning in the 2018 by purchasing the franchise of Microsoft 365 which became accessible to all employees and students. The MS 365 platform includes certain applications such as the MS Teams (online classes) and MS Forms (online quizzes and activities) where faculty members can conduct lessons without worries of unfinished discussions in the course syllabus. It also includes the use of other online class platforms such as Edmodo, depending on the preference of faculty members. This coincided with NU's shift from a regular two-semester academic year to a tri-semester format. At the beginning of the academic year, the new General Education Curriculum (GEC) mandated by the Philippine Commission on Higher Education (CHED) has been implemented. One of the included subjects was Readings in Philippine History (RIPH) which emphasizes the teaching of Philippine History through examination of primary and secondary sources. With the volume of sources that can be examined, it is imperative if these fit the Outcomes Based Education (OBE) system of instruction. As such, this study determined the predictive values of instructional delivery to the test performance of the students. Specifically, it ascertained the effectiveness of blended learning in terms of improving the academic success of the students.

## **2. Literature Review**

### ***2.1. Learning Management Systems***

Today's HEIs expand their educational infrastructure through the LMS in order to accommodate increased enrollment and diversified classes, and support teaching and learning

(Dobre, 2015). In an educational context, e-learning platforms are also known as Learning Management Systems (LMSs) which are “*internet based, software allowing instructors to manage materials distribution, assignments, communications and other aspects of instructions for their courses*” (Abu Shawar, 2009, p. 3, as cited in Jamal, & Shanaah, 2011). An LMS is defined as “*a software (web) application used to plan, implement, and assess learning processes*” (About E-learning, 2016). [sic.]. Examples of which are Canvas, Edmodo, Moodle and Microsoft Teams. These are known by various names such as course management system (CMS), learning content management system (LCMS), virtual learning environment (VLE), and virtual learning system (VLS) (Wright et al., 2014). This integration between technologies and educational environment has facilitated the communication between students and teachers, but at the same time raised new challenges as well (Pishva et al., 2010, as cited in Jamal & Shanaah, 2011). According to the University of Buffalo, Center for Educational Innovations (n.d), as LMSs become increasingly essential for enhancing high quality teaching and learning, there is a strong need to choose an appropriate LMS in order to enhance faculty teaching and student learning.

### ***2.1. Blended Learning***

The use of technology in higher education is evident (Peterson, 2013) and blended learning environment is becoming common (Mantyla, 2001). Trpkovska (2011) considers blended learning instruction more effective than the traditional approach. The term blended learning is generally referred to as a combination of online and face-to-face instruction (Graham, 2013). It is the “*organic integration of thoughtfully selected and complementary face-to-face and online approaches and technologies*” (Garrison & Vaughn, 2008, p. 148). Christenson, Horn, and Staker (2013) add that it is a formal education program in which a student learns at least in part through online learning with some element of student control over time, place, path, and/or pace and at least in part at a supervised brick-and-mortar location away from home. When designed and implemented appropriately, blended learning supports some degree of personalized learning (O’Byrne & Pytash, 2015). It embraces the use of online environments to offer complementary learning experiences that allow face-to-face time and space to be used more efficiently and effectively (Garrison & Vaughan, 2008; Glazer, 2011; Hoffman, 2006; Johnson et al., 2015; McGee & Reis, 2012; Murphy et. al., 2014; O’Byrne & Pytash, 2015).

The challenge for teachers is designing and implementing an effective and efficient blended learning course. Any program should offer formal online and blended instruction paired with occasions for experiential learning and reflection (Kennedy & Archambault, 2012). In terms of teaching methods, a mix of various methods leads to effective learning (Danaei, 2010) but it should suit the subject matter (Adunola, 2011). The integration of an online and classroom environment is likely to combine ideally the advantageous aspects of both types of instruction. It is important for instructional designers and distance educators to offer more flexible delivery options, provide more controls to students and design meaningful opportunities (Giannousi et. al., 2014). Ozkan and McKenzie (2008) as cited by Ally (2012) contend that educators need to engage students with shared understanding, collaborate in discussions, and share common resources, such as readings, links, and videos (McCann, 2009 as cited by Ally, 2012).

The internet's role in changing the form of teaching is transformative (Franzoni & Assar; Greenhow et al. 2009, as cited in Ally, 2012). Recent research emphasizes the need for interaction and collaboration in online learning (Bower, Dalgarno, Kennedy, Lee & Kinney, 2014; Goodyear & Zenios, 2007; Benbunan-Fich, Hiltz, & Harasim, 2005 as cited in Power & St-Jacques, 2014 ), because knowledge-building occurs in a social environment and is greatly influenced by mutual interaction (Brown & Duguid, 2000 as cited in Giannousi, et.al, 2014). Interaction allows students to collectively construct meaning by integrating various perspectives (Barr & Tagg, 1995 as cited in Power & St-Jacques, 2014) while collaboration provides them with the opportunity to “expand their knowledge base together” (Angelino, Williams & Natvig, 2007 as cited in Power & St-Jacques, 2014).

## ***2.2. Learning Theories***

According to Mayes and De Freitas (2004) there are distinct traditions in educational theory that derive from different perspectives about the nature of learning itself. Learning theories are important as a solid pedagogical foundation to the design of blended learning. There are three widely recognized learning models that profess blended learning which are cognitivist, constructivist, and socially situated model of learning (Hadjerrouit, 2008). In addition, Greeno, Collins and Resnick (1996) cited in Jamal and Shanaah (2011) identify three clusters or broad perspectives crucial to the understanding of learning which are

*associationist/empiricist* perspective (**learning as activity**), *cognitive* perspective (**learning as achieving understanding**) and *situative* perspective (**learning as social practice**).

***The Cognitive perspective.*** Knowledge acquisition was viewed as the outcome of an interaction between new experiences and the structures for understanding that have already been created. Building a framework for understanding becomes the learner's key cognitive challenge (Mayes & De Freitas, 2004). Increasingly, mainstream cognitive approaches to learning have emphasized the assumptions of *constructivism* that understanding is gained through an active process of creating hypotheses and building new forms of understanding through *activity*. In other words, constructivism in learning theories is defined as active construction of new knowledge based on a learner's prior experience (Koochang et al., 2009).

***The Situative (Social) perspective.*** A learner will always be subjected to influences from the social and cultural setting in which the learning occurs, which will also define at least partly the learning outcomes. This view of learning focuses on the way knowledge is distributed socially. This can be seen as a necessary correction to theories of learning in which both the behavioral and cognitive levels of analysis had become disconnected from the social. Activity, motivation and learning are all related to a need for a positive sense of identity (or positive self-esteem), shaped by social forces (Mayes & De Freitas, 2004).

***Community of Inquiry (COI).*** An educational community of inquiry is a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding (Teaching and Learning Center, 2007). According to Garrison et al. (2000) a worthwhile educational experience is embedded within a COI that is composed of teachers and students - the key participants in the educational process. This model was developed as a framework for assessing the learning process and context in online environments in the late 1990's (McKerlich & Anderson, 2007). The model and its component parts have been confirmed and replicated using a variety of research methodologies. It has its roots in Dewey's (1933, as cited in Jamal & Shanaah, 2011) practical inquiry, Lipman's community of inquiry and Garrison's (1991) model of critical thinking (McKerlich & Anderson, 2007). The COI framework represents a process of creating a deep and meaningful (collaborative-constructivist) learning experience through the interaction of three interdependent elements, which are crucial prerequisites for a successful higher

educational experience. Those three elements are social presence, cognitive presence and teaching presence.

### ***2.3. Factors Affecting Test Performance***

According to Rasul and Bukhsh (2011), there are several factors that affect the examination performance of the students. The result of the examination cannot be solely blamed to students. For instance, a cross-sectional study conducted by Sansgiry et.al (2006), GPA results of pharmacy students differ due to factors that contributed to their academic performance such as test competence, time management, studying techniques and test anxiety. In addition, Rift Valley University considered several variables to identify the factors that affect the academic performance of students. Likewise, Akkesa and Dhufera (2015) found out that teachers' performance and attitude has a significant impact to students, the same way that school facilities and resources, and socio- economic status of family affect the academic achievement of the students.

In a study conducted in South African University, the students' academic performance can also be affected by the way the instructor presents a module or a lesson. The attitude of students towards the subject is also dependent on how the instructor delivers them (Silkwari et.al, 2015 as cited in Arora and Singh, 2017). Also, according to Shaari et.al (2014), the various teaching methods used in the classroom can help the students understand subject matter. More so, for effective transfer of learning, designing a good instructional material which also include learning activities and needs assessment is necessary. It should focus on the level of students' competency and the use of various instructional delivery (Lim & Morris, 2009). Meador (2019) mentions that one of the ways to boost student learning is through an effective instructional strategy. When teacher uses wide range of instructional strategies, the students are stay engaged in learning.

## **3. Methodology**

This study used the classic quasi-experimental design of Two-Groups, Random Selection, Pre-test, post-test design. The pretest was used as a means to measure a starting point or the amount of pre-existing knowledge on the research topic; to compare with the starting point of a post-test; to compare with posttest results after the application or non-

application of treatments; draw conclusions as to whether treatments resulted to significant differences among pretest and posttest scores. Significant differences among pretest and posttest scores are indications that the treatment is effective.

Since this experimental design notation uses random selection of participants, it can guarantee that any differences that appear in the post test are the results of the experimental variable/s (treatment and non-treatment) instead of the potential difference between the two groups to begin with. This classical type of experimental design has a good internal validity. The external validity or generalizability of the study is limited by the possible effect of pre-testing. The limitation was addressed by administering the posttest questionnaires to the participants three months after the administration of pretest questionnaires.

**Table 1**

*Two-Groups, Random Selection, Pretest and Posttest design notation*

Groups	Pre-test	Treatment	Post-test
<i>Treatment/ Experimental Group= E (R)</i> (N=31)	O	X	O
<i>Control Group= C (R)</i> (N=31)	O		O

Pretest and posttest questionnaires have similar content and number of items. The same pretest and posttest questionnaires were used for both treatment and control group. Table 1 shows the notation of the experimental design (classic two-groups, random selection, pretest and posttest design). Participants of both treatment and control groups were randomly selected first year students taking up the course in *Readings in Philippine History*. In the context of this study, treatment refers to” exposure blended-learning”.

After answering the validated pretest questionnaires, the experimental/ treatment group (n=31) was exposed to blended learning for the entire term (1 term= 3.5 months). Before the end of the term, the treatment group was asked to answer the same validated questionnaire for the posttest. The pretest and posttest scores were subjected to a series of statistical tests.



Just like the treatment group, the control group (n=31) answered the validated pretest questionnaires. Although the control group was not exposed to treatment (blended learning), this group was exposed to classroom interaction/ face-to-face type of learning. Just like the treatment group, the control group was asked to answer the same validated questionnaires for posttest. The pretest and posttest scores were likewise subjected to a series of statistical tests.

In order to ensure that the main instrument for data gathering is reliable and the reliability coefficient is adequate, the pilot testing (test-and re-test method) was conducted which involved randomly selected sixty-five (65) first year tertiary students who were about to take up course in *Readings in Philippine History*.

**Table 2**  
***Reliability Coefficient of the Main Data Gathering Instrument***

	<i>Pretest</i>	<i>Posttest</i>
Pretest	1	
Posttest	0.78	1

*Legend: 0.91- 1.00 Very High Reliability; 0.71 - 0.90 High Reliability; 0.51 - 0.70 Moderate Reliability; 0.31 - 0.50 Low Reliability; 0.00 - 0.30 Little or No Reliability*

The data shown in Table 3 reflects a high positive correlation with a value of 0.78 which denotes a high reliability. To make sure that the scope and constructs of the instruments used reflect the real meaning of the study and empirical measurements are adequate enough to achieve the aims/objectives of the study, the researchers tested the face and content validity of the questionnaires. To test the validity of the instrument/s and its constructs, at least five (5) subject matter and research experts within the university were requested to perform face and content validity.

All answered pre-test and post-test questionnaires were manually encoded. Data from quantitative aspect of the questionnaires were processed using MS Excel ToolPak, JMP11 Statistical Discovery Software, QI Macros Statistical Software and R-Software. The researchers created a data base and encoding worksheets in Microsoft Excel. Quantitative data were presented in Q-Sort-tables. After encoding and tallying the answers of the participants, the ratings were statistically interpreted (descriptive and inferential statistics).

Frequencies, weighted means, and standard deviations were calculated. Frequency and percentage of responses were determined, comparisons of scores among the control group (group not exposed to blended learning) and treatment group (group exposed to blended learning) were made for descriptive purposes.

### 3. Results and Discussion

To determine the type of test (parametric and non-parametric tests) to be used, the Levene’s test was conducted. The purpose of this test is to ascertain variance homogeneity, a pre-condition for parametric tests (such as t-Test, ANOVA and ANCOVA) and other post-hoc test.

**Table 3**  
*Results of Levene’s Test- Control and Treatment Groups*

Experimental Groups	Descriptive Statistics			Levene’s Test					
	Mean	Median	Variance	w	P-Value	F	F-Critical	Decision	
Control Group (N=31)	Pre-Test	31	31	21.47	0.13	0.72	1.23	1.84	<b>Hypothesis 1:</b> Cannot Reject Null Hypothesis because $p > 0.05$ (Variances are the same). Parametric Tests can be performed
	Post-Test	31.61	31	17.45					
Treatment Group (N=31)	Pre-Test	28.10	29.00	20.49	0.82	0.37	.96	.54	
	Post-Test	33.61	33.00	21.45					

*H<sub>01</sub>: The variances of the scores of control group are not significantly different, therefore t-Test, ANOVA, ANCOVA in Regression Analysis notation can be performed.*

*H<sub>02</sub>: The variances of the scores of treatment group are not significantly different, therefore t-Test, ANOVA, ANCOVA in Regression Analysis notation can be performed.*

In Levene's test, if the level of significance is lower than the alpha ( $\alpha=0.05$ ), then the variances are significantly different and parametric tests cannot be performed. Table 3 shows the results of the Levene's test for variances. The Levene's test for the pre-test and post-test scores of the control group yielded a *p-value* of 0.72 which is much higher than the *alpha* ( $\alpha=.05$ ), therefore there is no significant difference among the variances of the control group's pretest and posttest scores and parametric tests can be performed. The 2-tailed null hypothesis which states that *the variances of the scores of control group are not significantly different, therefore t-Test, ANOVA, ANCOVA in Regression Analysis notation can be performed* is accepted and the alternative hypothesis is rejected.

The Levene's test for the pre-test and post-test scores of the treatment group yielded a *p-value* of 0.37 which is much higher than the *alpha* ( $\alpha=.05$ ), therefore there is no significant difference among the variances of the treatment group's pretest and posttest scores and parametric tests can be performed. The 2-tailed null hypothesis which states that *the variances of the scores of treatment group are not significantly different, therefore t-Test, ANOVA, ANCOVA in Regression Analysis notation can be performed* is accepted and the alternative hypothesis is rejected.

It is a common practice to first test the variance for homogeneity in order to find out whether parametric or non-parametric test should be used. This test was performed since the initial option was to use parametric tests (i.e., t-test, ANOVA and ANCOVA). Homogenous variance is a pre-condition for ANOVA, t-Test and ANCOVA. After establishing that the variance of the scores of the participants are indeed homogenous, the t-Test, ANOVA and ANCOVA with Regression analysis notations were initiated to determine the significant difference and the treatment effect for pre-test- post-test two-group experimental design. Post-hoc analyses were also conducted for tests that yielded significantly different pre-test and post-test scores or groups affected by the treatment.

The use of ANCOVA with regression analysis notations (bivariate, multivariate and simultaneous bivariate notations) ascertains how much variation was caused by one variable in relation with the variation caused by another variable. It also determined the magnitude and direction of relationships between the treatments used (pure classroom interaction/ non-exposure to blended learning and exposure to blended learning) and increase or decrease in Post-test scores. Using the statistical program "R" (R Core Team, 2014), the significant

difference among Pre-test and post-test scores were determined to establish whether or not there is a treatment effect to both observation and control groups. By regressing the pre-test and post-test scores, it was able to determine the existence of relationship between and among the dependent (explanatory variables (test scores)) and independent (explained variables (treatments)).

**Table 4**  
*Comparison of Post-Test Scores between Control and Treatment Group*

POST-TEST SCORES	Control Group		Treatment Group	
	F	%	f	%
Higher Post-Test Sores	15	48.39%	23	74.19%
Lower Post-Test Scores	13	41.94%	4	12.90%
Same Pre-test & Post-test Scores	3	9.68%	4	12.90%
<b>Total</b>	<b>31</b>		<b>31</b>	

Based on Table 4, for control group, 48.39% of the participants got higher post-test scores; 41.94% of the students got lower scores; and 9.68% got the same pre-test and post-test scores. The majority or 74.19% of the participants from the treatment group obtained higher post-test scores; while 12.90% got lower post-test scores and 12.90% got the same pre-test and post-test scores.

As shown in Table 5, the post-test scores of control group (N=31) or group of students who were not exposed to blended learning obtained a mean of 31.6129 which is 1.98% higher than the weighed mean of their pre-test scores (X=31). On the other hand, the mean of the post-test scores (X=33.6129) of the treatment group or students who were exposed to blended learning is 19.63% higher than the weighted mean of their pre-test scores (X=28.09677). *t*-Test compares the means of two separate samples and determines the significant differences, thus, in the current study, the significant differences among the pre-test scores and pos-test scores of the control group and treatment group indicate the effectiveness of treatment applied to each group. For the control group, the observed value (*t*-Stat=-0.965) is lesser than the critical value (*t*-Critical=1.697), and the *p* value (*p*=0.342) is greater than the alpha (*a*=0.05), therefore there is no significant difference among the pre-test and post-test scores of the control group. This indicates that the null hypothesis of no treatment effect should be accepted and the alternative hypothesis that classroom interaction is effective in improving the test scores of the control

group. Since the observed value ( $t\text{-Stat}=-6.529$ ) is greater than the critical value ( $t\text{-Critical}=1.697$ ), and the p-value ( $p=0.00$ ) is lesser than the alpha ( $\alpha=0.05$ ), there is a significance difference among the pre-test scores and post-test scores of the treatment group. The null hypothesis of no treatment effect of blended should be rejected in favor of the alternative hypothesis that blended learning is effective in improving the test scores of the treatment group.

**Table 5**  
***t-Test Analyses Results***

Pre-Test and Post-Test Scores	df	Mean	Diff	Variance	t-Stat (Observed Values)	t-Critical (Critical Value)	P-Value	Interpretation	Decision
<b>Control Group (N=31)</b> <b>Treatment:</b> <i>Pure classroom-based interaction/ non-exposure to Blended-Learning</i>	30	Pre-Test= 31 Post-test= 31.6129	0.6129	Pre-Test= 21.466667 Post-Test= 17.44516	-0.965	1.697	$P=0.342$	Post-Test>Pre-Test (1.98% Increase in Post-Test Scores) $t\text{-Stat}<t\text{-Critical}$ $p(0.34)>\alpha(0.05)$ <b>Classroom has no treatment effect</b>	Accept Ho of no treatment effect
<b>Treatment Group (N=31)</b> <b>Treatment:</b> Exposure to both classroom-based and online-based learning/ Blended-Learning	30	Pre-Test= 28.09677 Post-Test= 33.6129	5.516	Pre-Test= 20.49032 Post-Test= 21.44516	-6.529	1.697	$p=0.00$ $(3.20702E-07)$	Post-Test>Pre-Test (19.63% Increase in Post-Test Scores) Post-Test>Pre-Test $p(0.00)<\alpha(0.05)$ <b>Blended Learning is effective</b>	Reject Ho of no treatment effect

$\alpha = .05$ ; Level of Significance= 95%

$H_{03}$ : There is no significant difference among the pre-test scores and post-test scores of the control group. Thus, classroom interaction has no treatment effect.

$H_{04}$ : There is no significant difference among the pre-test scores and post-test scores of the treatment group. Thus, blended learning has no treatment effect.

Table 6 shows that classroom interaction or non-exposure to blended learning ( $0.243 > \alpha$ ), has no relationship with the post-test scores of control group because the p-value is much higher than the lower than the alpha ( $\alpha=0.5$ ) or level of significance. Therefore, the null hypothesis is accepted and the alternative hypothesis is rejected. The correlation between

non-exposure to blended learning and increase in post-test scores is weak as shown in the value of Multiple R (0.216).

**Table 6**

**Results of ANCOVA (in Regression Analysis Notation) of Test Scores of Control and Treatment Group)**

	Multiple R	R-Square	Adjusted R-Square	Coefficients	Standard Error	P-value	DECISION
<b>Control Group</b>	0.216	0.047	0.014	-0.02385355	0.458	0.243	<b>Accept Ho of no treatment effect</b>
<b>Treatment Group</b>	0.473	0.223	0.197	0.483417296	4.151	0.007	<b>Reject Ha</b> <b>Reject Ho of no treatment effect</b> <b>Accept Ha</b>

*H<sub>05</sub> Classroom interaction type of learning has no effect to the post-test scores of the control group. Classroom interaction has no influence on higher test scores.*

*H<sub>05</sub>: Blended learning has no effect to the post-test scores of the treatment group. Blended learning has no influence on higher test scores.*

*H<sub>07</sub> Classroom interaction type of learning has no influence to the post-test scores of the control group after removing covariates/ regressors*

*H<sub>08</sub>: Blended learning has no influence to the post-test scores of the treatment group after removing covariates/ regressors*

The strength of relationship between classroom interaction and higher post-test scores is shown in the value of R square (0.047) which means that only 4.47% of the changes in post-test scores can be attributed to classroom interaction. After removing the effects of covariates, the coefficient of determination (adjusted R square) yielded a value of 0.014, indicating that only 1.40% of the observed variance on the control group’s test scores can be ascribed to classroom interaction with the other 98.60% possibly caused by other factors. After removing the effects of covariates, the coefficient of determination (adjusted R square) yielded a value of 0.014, indicating that only 1.40% of the observed variance on the control group’s test scores can be ascribed to classroom interaction with the other 98.60% possibly caused by other factors.

**Table 7*****ANOVA/ Source of Test Scores of Control and Treatment Group***

Groups	SS	MS	F	t-stat
Treatment Group	0.297784644	0.297784644	1.418182299	1.190874594
Control Group	143.6529076	143.6529076	8.336838542	4.205575248

*a= 0.05*

Exposure to blended learning ( $0.007 < \alpha$ ), has a relationship with the post-test scores of treatment group because the p-value is much lower than the alpha ( $\alpha=0.5$ ) or level of significance. Therefore, the *null hypothesis rejected* and the *alternative hypothesis is accepted*. The correlation between exposure to blended learning and increase in post-test scores is weak as shown in the value of Multiple R (0.473). The strength of relationship between classroom interaction and higher post-test scores is shown in the value of R square (0.223) which means that only 22.30% of the changes in post-test scores can be attributed to blended learning. After removing the effects of covariates, the coefficient of determination (adjusted R square) yielded a value of 0.197, indicating that 19.70% of the observed variance on the treatment group's test scores can be ascribed to blended learning with the other 80.30% possibly caused by other factors.

**Table 8*****Point Biserial Correlation Coefficient of Non-Exposure to Blended Learning and Changes in Test Scores***

Non-exposure to blended learning and changes in test scores.	$R_{pb}$	Interpretation	Decision
	+0.68211	Substantial Positive Association	Reject $H_0$ Accept $H_a$

*H<sub>09</sub>: There is no association between non-exposure to blended learning and changes in test scores of control group.*

As shown in Table 8, the Point Biserial Correlation Coefficient of *non-exposure to blended learning and changes in test scores* is 0.68211. This indicates that there is a substantial association between non-exposure to blended learning and changes in test scores of the control group. Thus the 1-tailed null hypothesis which indicates that *there is no association between non-exposure to blended learning and changes in test scores of control group* is rejected and the alternative hypothesis is accepted.

**Table 9**

***Point Biserial Correlation Coefficient of Exposure to Blended Learning and Changes in Test Scores***

<b>Exposure to blended learning and changes in test scores.</b>	<b>R<sub>pb</sub></b>	<b>Interpretation</b>	<b>Decision</b>
	+0.56104209	Substantial Positive Association	Reject Ho Accept Ha

*H<sub>010</sub>: There is no association between exposure to blended learning and changes in test scores.*

Table 9 shows that the Point Biserial Correlation Coefficient of exposure to blended learning and changes of test scores is 0.5610429. This means that there is a substantial positive association between exposure to blended learning and changes in the test scores of treatment group. Thus, the null hypothesis of no association between exposure to blended learning and changes of test scores is rejected. The alternative hypothesis is accepted.

**Table 10**

***Point Biserial Correlation Coefficient of Type of Learning and Increase in Test Scores of both control and treatment groups.***

<b>Type of Learning and Increase in Test Scores</b>	<b>R<sub>pb</sub></b>	<b>Interpretation</b>	<b>Decision</b>
	+0.5655262	Substantial Association	Reject Ho Accept Ha

*H<sub>011</sub> There is no association between the type of learning and increase in test scores of both control and treatment groups.*

As shown in Table 10, there is a substantial association between the type of learning and increase in test scores of both control and treatment groups as indicated by its Point Biserial Correlation Coefficient of 0.5655262. As a result, the 1-tailed null hypothesis of no association between the type of learning and increase in test scores of both control and treatment groups is rejected and alternative hypothesis is accepted.

**Table 11**

***Point Biserial Correlation Coefficient of Type of Learning and Decrease in Test Scores***

<b>Type of Learning and Decrease in Test Scores</b>	<b>R<sub>pb</sub></b>	<b>Interpretation</b>	<b>Decision</b>
	-1.00	Very Strong Negative Association	Reject Ho Accept Ha

*H<sub>012</sub> There is no association between the type of learning and decrease in test scores of both control and treatment groups.*



As shown in Table 11, there is a very strong negative association between the type of learning and decrease in test scores of both control and treatment groups as indicated by its Point Biserial Correlation Coefficient of -1.00. Therefore, the 1-tailed null hypothesis of no association between the type of learning and decrease in test scores of both control and treatment groups is rejected and alternative hypothesis is accepted.

**Table 12**

***Point Biserial Correlation Coefficient of Type of Learning and Test Results of both Control and Treatment Groups***

Type of Learning and Test Results	$R_{pb}$	Interpretation	Decision
	+1.00	Very Strong Positive Association	Reject $H_0$ Accept $H_a$

**$H_{013}$**  *There is no association between the type of learning and test scores of both control and treatment groups.*

Table 12 conveys that there is a very strong positive association between the type of learning and test results of both control and treatment groups as indicated by its Point Biserial Correlation Coefficient of 1.00, leading to the rejection of 1-tailed null hypothesis of no association between the type of learning and test results of both control and treatment groups and acceptance of alternative hypothesis.

#### **4. Conclusion**

Apart from yielding higher post test scores after exposure to blended learning, there is a significance difference among the pre-test scores and post-test scores of the treatment group; higher scores in the post-test reveal that blended learning is effective in improving the test scores of the treatment group (( $t$ -Stat=-6.529), ( $t$ -Critical= 1.697), and ( $p=0.00$ )).

There is no significant difference among the pre-test and post-test scores of the control group, which indicates that face-to-face leaning/ classroom interaction alone is not effective in improving the test scores. On the other hand, there is a significance difference among the pre-test scores and post-test scores of the treatment group, thus blended learning is effective in improving the test scores of the treatment group.

Classroom interaction or non-exposure to blended learning has no relationship with the post-test scores of control group. Classroom interaction or non-exposure to blended learning

has no relationship with the post-test scores of control group. Exposure to blended learning has a relationship with the post-test scores of treatment group.

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